

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND AND PROVIDE MEANS TO QUANTIFY THE IMPACTS OF RIVER CONTAMINATION ON RECEPTORS

Identification No.: RL-SS39

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating:

This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Understand and Provide Means to Quantify the Impacts of River Contamination on Receptors

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG

Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The primary technical gap associated with the impacts of river contamination on receptors is that there is an insufficient understanding of the human, ecological, cultural and socio-economic impacts of contaminants that reach the river and the relationship between contaminants entering the river and behavioral impacts on culture and socio-economics. Currently, standard impact assessment practice involves comparing estimated exposures of individual organisms to a lowest observed effects level toxicological benchmarks, such as behavioral change or tissue-level alterations. Regulated exposure levels are sometimes also based on no observed effects levels, which have a number of inadequacies aside from their level of biological resolution (Chapman et al. 1996). In either case, however, the interest of regulation and impact assessment is not at the individual or sub-individual level, but at the level of the population and its properties, such as abundance, health, productivity, etc. There is a need to develop consistent metrics upon which to determine impacts (human, ecological, cultural, socio-economic) that are useful in the decision-making process and reflective of appropriate level of organization of the focus receptor groups. The development of consistent metrics includes the quantitative capability for translating an individual-level dose-response into the impact metrics that are important to regulators and stakeholders, including the general public (see Levin et al. 1989, Newman and Jagoe 1996).

Specific technical gaps associated with the development of impact metrics include the following.

- Appropriate toxicological benchmarks need to be developed for contaminants likely to enter the river, involving species important from ecological and human perspectives. This need includes information to determine the impacts from diverse contaminant mixtures, e.g., accounting for potential synergistic/antagonistic effects.
- Understanding the ecological interactions and processes within the affected system such that a reasonable prediction of higher-order effects (e.g., at the population level) can be made based on toxicological benchmarks. For example, translating a genetic-level toxicological benchmark into a population survival/productivity change effect.
- Information is needed to translate ecological impacts into cultural and socio-economic impacts.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information

associated with impacts of contamination is needed in the FY04 timeframe to meet these objectives.

Problem Description: This need falls under the River Technical Element within the S&T Endeavor. The River Technical Element is intended to support and provide information necessary for an assessment of the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources. The objectives of the river technical element are to provide relevant and meaningful information to support remedial decisions and subsequent risk and system assessments, to guide ongoing and subsequent environmental surveillance programs, and to focus future iterations of the cumulative river assessment. Meeting the objectives will enhance protection of human health and the environment by providing scientifically defensible knowledge and data and identifying existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The scope of this technology need includes effects of contaminant exposures on the biota, cultures, and socioeconomics associated with the Columbia River.

Key issues in this technical area include developing credible conceptual and numerical models for (1) identifying toxicological impacts to the river's ecosystem; and (2) quantifying meaningful effects relative to ecological attributes and human receptors. Key information needs include identifying (1) toxicological benchmarks for regional species of concern for contaminants of concern; (2) definitions of desired metrics to assess impacts; (3) effects of complex contaminant mixtures; and (4) translational models for converting toxicity into impact metrics for human and ecological endpoints.

Benefit to the Project Baseline of Filling Need: Information gained by filling this need will reduce the uncertainty in the technical basis for quantifying the impacts of river contamination on receptors. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must provide an accurate understanding of current conditions over time and the ability to assess potential future conditions, near- and long-term. In addition, the evaluation must allow for the differentiation between contaminant contributions from Hanford and other sources (natural and/or anthropogenic). The information obtained must be applicable toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown

Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of the human, ecological, cultural and socio-economic impacts of contaminants that reach the river and the relationship between contaminants entering the river and behavioral impacts on culture and socio-economics. This information is necessary to accurately and credibly assess of risk posed by Hanford Site contaminants to aquatic, terrestrial, and human receptors in the river environment.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

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DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

Chapman, P. M., R.S.Caldwell, and P. F. Chapman. 1996. A warning: NOECs are inappropriate for regulatory use. Environ. Toxicol. Chem. 1996; 15(2):77-79.

Newman, M.C., and C.H. Jagoe, eds. 1996. Ecotoxicology, A Hierarchical Treatment. CRC Press, Boca Raton, Florida.

Levin, S.A., M.A. Harwell, J.R. Kelly, and K.D. Kimball, eds. 1989, Ecotoxicology: Problems and Approaches. Springer-Verlag, New York.

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

Inventory Element Index to Linked Needs.

RL-SS40	Provide a method to develop mass balance (i.e., holistic) inventory estimates
RL- WT090	Chemical and Physical Behavior of Sludge Wastes
RL- WT091	Chemical and Physical Behavior of Saltcake Wastes
RL-WT070	Uncertainty Estimation of Hanford Best Basis Toxic Waste Inventory, Concentration, Phase and Waste Type
RL-WT01	Technetium-99 Analysis in Hanford Tank Waste and Contaminated Tank Farm Areas
RL-SS42	Provide method for more accurate estimates of waste constituent release rates and modes from waste
RL-WT068	Radionuclide Source Term from Tank Residuals